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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/608,639	06/30/2003	Myung-Ah Kang	SEC.1051	8355

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EXAMINER

RUGGLES, JOHN S

ART UNIT	PAPER NUMBER
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1756

DATE MAILED: 03/30/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/608,639

Applicant(s)

KANG ET AL.

Examiner

John Ruggles

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 18 February 2005 and 30 June 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-11 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-11 is/are rejected.
- 7) ☒ Claim(s) 2 and 7-11 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 30 June 2003 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date 2/18/05.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

Drawings

The drawings are objected to because the numbering of Figures 1A-1D does not match that (e.g., Figures 1(a)-1(d), etc.) used in the specification at paragraphs [0020-0030 and 0080].

The drawings are objected to as failing to comply with 37 CFR 1.84(p)(4) because reference character “100” in Figure 3A has been used to designate both (A) a PEPSM and (B) a quartz substrate in the description thereof at paragraph [0090] lines 1-2. Figure 3A is also objected to because it appears to be inverted with respect to the corresponding description found at [0090] (e.g., so that the trench upper surface is described to be the trench bottom surface, etc.).

The drawings are further objected to because Figure 4 has an inconsistent horizontal scale for the line width of the auxiliary pattern (nm) with the distance between “0” nm and “50” nm being the same as that between the other numbers (e.g., “50” nm, “75”nm, “100”nm, etc.). In response to this objection, Applicants must clarify whether or not “0” nm on the horizontal scale was originally intended to be --25-- nm.

Moreover, Figure 4 shows an apparent non-linearity of the relationship between the line width of the auxiliary pattern and that of the resulting resist pattern, especially for auxiliary pattern line widths either below 50 nm or above about 125 nm. However, this apparent non-linearity is not sufficiently represented by the statement “every increase of 25 nm in the line width of the auxiliary pattern 120 may produce an increase of 10 nm in the line width of the photoresist pattern” in the corresponding description found at [0100] lines 3-5. In this regard, the drawings are objected to under 37 CFR 1.83(a), because Figure 4 does not extend above auxiliary pattern line widths of 150 nm. The drawings must show every feature of the invention

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specified in the claims. Therefore, the entire range for the auxiliary pattern line widths from 30 nm to 200 nm (as recited by instant claims 6 and 11) must be shown or the feature(s) canceled from the claim(s). No new matter should be entered.

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Specification

The disclosure is objected to because of the following informalities: (1) at paragraph [0080] lines 6-7 in the brief description of Figure 1(b), "exposure light directed onto the conventional PEPSM" should be changed to --exposure light ~~directed onto~~ on the conventional PEPSM--, in order to be consistent with the latter meaning found at [0020] lines 2-3; (2) at

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[0110] line 5, "trench 110 is designed for so as to shift the phase of light by 180°" should be simplified to --trench 110 is designed ~~for so as~~ to shift the phase of light by 180°--; and (3) at [0125] line 9 to [0130] line 1, "becoming damage is small because the risks is formed on a stable planar surface. [0130] Finally, although, the present" should be amended to --becoming ~~damage~~ damaged is small because the ~~risks~~ auxiliary pattern is formed on a stable planar surface. [0130] Finally, although [[,]] the present-- (deletions are indicated by either strikethrough or double brackets, while additions are indicated by underlining).

Appropriate correction is required.

Claim Objections

Claims 2 and 7-11 are objected to because of the following informalities: (1) in both claim 2 lines 2-3 and claim 7 line 4, it is suggested that "the quartz substrate" be changed to --a quartz substrate--. Claims 8-11 depend on claim 7. Appropriate correction is required.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 3 and 8 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contain subject matter, which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. Applicants have failed to

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sufficiently define or even specify any working example for “an optical interference material” to be used for the auxiliary pattern as recited in claims 3 and 8. However, for the purpose of this Office action and in order to advance the prosecution of this application, the phrase “an optical interference material” has been interpreted reasonably broadly to mean --a material that reduces optical intensity so that patterning of the resist does not occur--, in accordance with [0090] lines 10-13 (e.g., opaque material, semi-transparent or halftone material, etc.).

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter, which the applicant regards as his invention.

Claims 1-6 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In claim 1 lines 3-5, it is unclear what was intended by a phase edge phase shift mask (PEPSM) having the following recited features: “a sidewall surface extending *from said top surface* and defining the sides of the trench, and *a bottom surface* extending from said sidewall surface and defining the *bottom* of the trench” (emphasis added). This language is not consistent with the most representative drawing of the PEPSM shown by Figure 3A, in which each trench 110 in the substrate of the PEPSM is actually positioned to have (a) a sidewall surface extending from a **bottom** surface to define the side of the trench and (b) an **upper** surface extending from said sidewall surface and defining the **upper** surface of the trench. However, Figure 3A is described in [0090] as though it was positioned upside down from that actually shown in the drawing (e.g., so that the trench upper surface is described to be the trench bottom surface, etc.).

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In response to this rejection, Applicants must amend at least claims 1-2, Figure 3A, and all applicable portions of the original specification to ensure that all are consistent with each other in respect to the position of the trench 110 in the substrate of the PEPSM. Claims 2-6 depend on claim 1.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-5 and 7-10 are rejected under 35 U.S.C. 102(b) as being anticipated by Ham (US Patent 5,567,552).

Ham teaches a (phase edge) phase shift mask (PEPSM, claims 3-4, Figure 2, and column 2 lines 60-63) and a method of fabricating such a PEPSM (abstract, Figures 1A-1F, and column 2 lines 13-59). As shown in Figure 2, the PEPSM 10 has a transparent quartz substrate 1 in which is etched grooves or trenches 3 of width B constituting 180° phase shift regions separated by an unetched transparent 0° region of width A, wherein each trench 3 has a sidewall surface 3A and a bottom surface extending therefrom. An opaque chrome (Cr) auxiliary pattern 5B is formed at the center of each trench bottom by coating Cr and etching back to leave only the desired portion of Cr (which specifically reads on the PEPSM and corresponding method of fabrication recited by instant claims 1-2, 4-5, 7, and 9-10; and further encompasses the PEPSM

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and corresponding method of fabrication recited by instant claims 3 and 8 for an auxiliary pattern of optical interference material that is opaque).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 6 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ham (US Patent 5,567,552) in view of Randall et al. (US Patent Application Publication 2002/0094492).

While teaching the other aspects of claims 6 and 11, Ham does not specify the line width of the opaque Cr auxiliary pattern to be 30-200 nm.

However, Cr line widths on a PSM in the instant range of 30-200 nm are well known. For example, Randall teaches a method of double exposure and a PSM therefore having orthogonal overlapping Cr regions 34 and 36 with critical line widths w_{34} and w_{36} , respectively, of 0.2 μ (200 nm, paragraph [0058] lines 4-6). Alternatively, a well-known "1X" mask having the same dimensions as those imaged on the resist for making a 0.16 μ (160 nm) wide gate electrode having a critical width includes a Cr opaque line width of 160 nm ([0004] lines 15-20, [0019] lines 7-11, [0038] lines 5-10, 22-26, and [0055] lines 18-22). Furthermore, gate electrode line widths on the order of 0.15 μ (150 nm) are also contemplated ([0012] lines 24-27) for a corresponding PSM having a Cr opaque line width of 150 nm (instant claims 6 and 11). It is desirable to fabricate integrated circuit device features that are as small and closely packed as

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possible to provide a high level of functionality and performance for the circuit, due to small feature sizes.

It would have been obvious to one of ordinary skill in the art at the time of the invention for the PEPSM and the corresponding method of fabrication taught by Ham to have employed an opaque Cr auxiliary pattern having a well-known line width of 150-200 nm (reading on the instant line width of 30-200 nm), so that the PEPSM would have features that are as small and closely packed as possible to provide a high level of functionality and performance, as taught by Randall, for a product (e.g., circuit device, etc.) made by patterned exposure through this PEPSM.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Kamon (US Patent 6,737,198) shows alternative embodiments of a PSM having etched recessed phase shifters (PS) and relatively narrow light shading, opaque, or optical interference auxiliary patterns 111 centered either at the bottom of the etched PS recesses in the substrate 10 (Figure 21G, column 17 line 49 to column 18 line 16) or on top of raised portions of the substrate 10 (Figure 22E, column 18 lines 17-36).

Steinberg et al. (US Patent Application Publication 2002/0031711) show an alternative embodiment of a multi-level PSM in Figure 9(e) having raised transparent mesas or pedestals 902 on a transparent substrate 905 and patterned opaque metal (e.g., Cr, etc.) regions 906 on both the raised 902 and recessed 905 areas of the substrate (paragraphs [0047, 0081]).

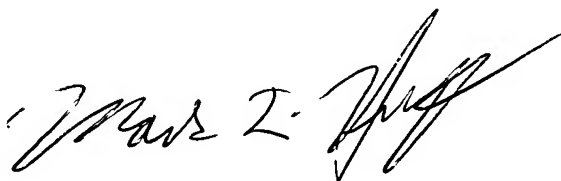
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These references are believed to read on instant Figures 3B and 5C.


Any inquiry concerning this communication or earlier communications from the examiner should be directed to John Ruggles whose telephone number is 571-272-1390. The examiner can normally be reached on Monday-Thursday and alternate Fridays.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 571-272-1385. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



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